

[0120] In other words, in a case where large diameter detection coil 43 detects an increase in the outer magnetic flux, the first voltage (V1) increases. If the inner magnetic flux decreases, the second voltage (V2) detected by small diameter detection coil 44 inversely decreases. Therefore, the ratio (V2/V1) between both voltages is sufficiently smaller than the set value, and, as result, it is possible to reliably detect the presence of metal foreign object 50 or 52 and to reliably perform a safety operation.

[0121] An operation of detecting metal foreign object 50 or 52 (determination based on the ratio V2/V1) is not substantially influenced by whether the metal foreign object is a magnetic body or a nonmagnetic body, or the type of charged mobile terminal 15. Therefore, the mobile terminal charging device can charge various mobile terminals 15 with versatility and is considerably convenient to use.

[0122] In the present exemplary embodiment, a description has been made of an example in which mobile terminal charging device 5 is provided in passenger compartment 2 of vehicle 1.

[0123] This is because a coin or the like is frequently placed on support plate 6 in vehicle 1.

[0124] In other words, in vehicle 1, mobile terminal 15 is deviated from the upper surface of support plate 6 due to inertia of an advancing direction or vibration during driving of the vehicle. Thus, as a countermeasure therefor, as illustrated in FIG. 3, guard portion 53 protruding upward from support plate 6 is provided at the outer circumference of support plate 6.

[0125] As a result, a state occurs in which a coin hardly falls off during driving of the vehicle, and this causes the coin to be placed on support plate 6.

[0126] Therefore, it is very useful to provide mobile terminal charging device 5 of the present exemplary embodiment in passenger compartment 2 of vehicle 1.

[0127] In the present exemplary embodiment, a description has been made of an example in which large diameter detection coil 43 and small diameter detection coil 44 are provided on the upper surface side of charging coil 8 (terminal charging coil 15a side). And, as illustrated in FIGS. 12 and 13, there may be a configuration in which intermediate diameter detection coil 54 is provided between large diameter detection coil 43 and small diameter detection coil 44 and is also connected to controller 10.

[0128] In other words, if intermediate diameter detection coil 54 is provided, switching between the detection coils 43, 44 and 54 for comparison can be performed, or situations between detection coils 43 and 54, and 54 and 44 can be detected.

[0129] In the above-described configuration, if power switch 40 illustrated in FIGS. 2 and 9 is turned on (step S1 in FIG. 19), a position of charging coil 8 is initialized (step S2 in FIG. 19).

[0130] The position initialization indicates that charging coil 8 is returned to the corner (coordinates x_0 and y_0) illustrated in FIG. 7 by driving motors 28 and 33.

[0131] In other words, switches 41 and 42 are present at the corner, and, if charging coil 8 is moved to the corner inside main body case 7 provided with switches 41 and 42, switches 41 and 42 are operated, and thus controller 10 determines that a position of charging coil 8 has been initialized.

[0132] Next, controller 10 supplies detection pulses to the above-described eight foreign object detection coils 55 (L1,

L2, L3, L4, L5, L6, L7, and L8), respectively. In a case where a resonance frequency of each of foreign object detection coils 55 is lower than a reference resonance frequency, held in memory 47, for each location where charging coil 8 is present, or in a case where a resonance voltage detected by each foreign object detection coil 55 is higher than a reference resonance voltage, held in memory 47, for each location where charging coil 8 is present, a safety operation is performed (steps S3 and S4 in FIG. 19).

[0133] In relation to detailed description thereof, FIG. 20 illustrates a state in which a resonance frequency of corresponding foreign object detection coil 55 is influenced by a location where charging coil 8 is present.

[0134] Specifically, line A of FIG. 20 indicates resonance frequencies of respective foreign object detection coils 55 (L1, L2, L3, L4, L5, L6, L7, and L8) when charging coil 8 is present at coordinates (10,0), and indicates a situation in which resonance frequencies of foreign object detection coils 55 (L8) near charging coil 8 are lowered.

[0135] Line B of FIG. 20 indicates resonance frequencies of respective foreign object detection coils 55 (L1, L2, L3, L4, L5, L6, L7, and L8) when charging coil 8 is present at coordinates (10,35), and indicates a situation in which resonance frequencies of foreign object detection coils 55 (L5) near charging coil 8 are lowered.

[0136] Line A of FIG. 21 indicates resonance voltages of respective foreign object detection coils 55 when charging coil 8 is present at coordinates (10,0), and indicates a situation in which a resonance voltage of foreign object detection coil 55 (L8) near charging coil 8 is heightened.

[0137] Line B of FIG. 21 indicates resonance voltages of respective foreign object detection coils 55 when charging coil 8 is present at coordinates (10,35), and indicates a situation in which a resonance voltage of foreign object detection coil 55 (L5) near charging coil 8 is heightened.

[0138] In other words, it has been found that a resonance frequency of foreign object detection coil 55 near charging coil 8 is lowered, and, conversely, a resonance voltage of foreign object detection coil 55 near charging coil 8 is heightened.

[0139] Line A of FIG. 22 indicates resonance frequencies of respective foreign object detection coils 55 in a case where a metal foreign object is absent when charging coil 8 is present at coordinates (10,0).

[0140] Line B of FIG. 22 indicates resonance frequencies of respective foreign object detection coils 55 in a case where a metal foreign object is present near fourth foreign object detection coil 55 when charging coil 8 is present at coordinates (10,0), and indicates a situation in which a resonance frequency of foreign object detection coil 55 (L4) near charging coil 8 is heightened.

[0141] Line A of FIG. 23 indicates resonance voltages of respective foreign object detection coils 55 in a case where a metal foreign object is absent when charging coil 8 is present at coordinates (10,0).

[0142] Line B of FIG. 23 indicates resonance voltages of respective foreign object detection coils 55 in a case where a metal foreign object is present at fourth foreign object detection coil 55 when charging coil 8 is present at coordinates (10,0), and indicates a situation in which a resonance voltage of foreign object detection coil 55 (L4) near charging coil 8 is lowered.

[0143] In other words, it has been found that a resonance frequency of foreign object detection coil 55 near the metal